

Magnetism and Matter

Question1

Which of the following statements is true in respect of diamagnetic substances?

KCET 2025

Options:

- A. They are feebly attracted by magnets
- B. Permeability is greater than 1000
- C. Susceptibility decreases with temperature.
- D. Susceptibility is small and negative

Answer: D

Solution:

The correct choice is Option D.

- Diamagnetic materials develop an induced magnetic moment opposite to an applied field, so their volume susceptibility is small and negative ($\chi < 0$).
 - They're actually repelled (not attracted) by a magnet.
 - Their permeability μ is just below 1 (not as high as 1000).
 - And unlike paramagnets, their susceptibility is essentially independent of temperature.
-

Question2

Magnetic hysteresis is exhibited by magnetic materials



KCET 2024

Options:

- A. Only para
- B. Only dia
- C. Only ferro
- D. Both para and ferro

Answer: C

Solution:

Magnetic hysteresis is exhibited by ferromagnetic materials.

In ferromagnetism, materials like iron and cobalt show hysteresis when subjected to an external magnetic field. The process involves the alignment of magnetic domains in response to the applied field and retains a certain level of magnetization even when the field is removed. This characteristic behavior, which results from the energy loss in the system, manifests as a lag between changes in magnetization and the external magnetic field, forming a hysteresis loop.

Therefore, the correct choice is:

Option C: Only ferro

Question3

Magnetic susceptibility of Mg at 300 K is 1.2×10^{-5} . What is its susceptibility at 200 K?

KCET 2024

Options:

- A. 18×10^{-5}
- B. 180×10^{-5}



C. 1.8×10^{-5}

D. 0.18×10^{-5}

Answer: C

Solution:

We know that magnetic susceptibility,

$$\begin{aligned}\chi &\propto \frac{1}{T} \\ \Rightarrow \frac{\chi_2}{\chi_1} &= \frac{T_1}{T_2} \Rightarrow \chi_2 = \frac{T_1}{T_2} \times \chi_1 \\ &= 1.2 \times 10^{-5} \times \frac{300}{200} = 1.8 \times 10^{-5}\end{aligned}$$

Question4

The Curie temperature of cobalt and iron are 1400 K and 1000 K respectively. At $T = 1600$ K, the ratio of magnetic susceptibility of cobalt to that of iron is

KCET 2023

Options:

A. $1/3$

B. 3

C. $7/5$

D. $5/7$

Answer: B

Solution:

We know that, magnetic susceptibility,



$$\chi = \frac{C}{T - T_C}$$

$$\therefore \chi \propto \frac{1}{T - T_C}$$

$$\begin{aligned} \Rightarrow \frac{\chi_{\text{cobalt}}}{\chi_{\text{iron}}} &= \frac{T - (T_C)_{\text{iron}}}{T - (T_C)_{\text{cobalt}}} \\ &= \frac{1600 - 1000}{1600 - 1400} = \frac{600}{200} = 3 \end{aligned}$$

Question5

The horizontal component of Earth's magnetic field at a place is 3×10^{-5} T. If the dip at that place is 45° , the resultant magnetic field at that place is

KCET 2023

Options:

- A. 3×10^{-5} T
- B. $\frac{3}{\sqrt{2}} \times 10^{-5}$ T
- C. $3/2\sqrt{3} \times 10^{-5}$ T
- D. $3\sqrt{2} \times 10^{-5}$ T

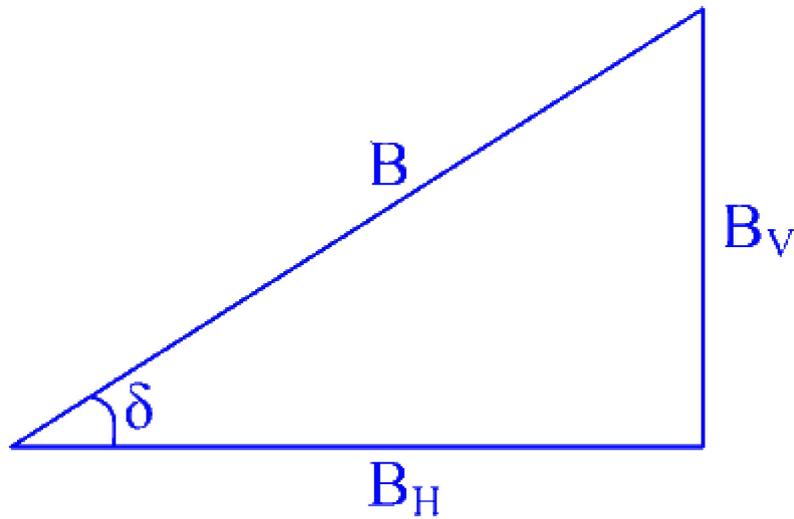
Answer: D

Solution:

Given, $B_H = 3 \times 10^{-5}$ T

$\delta = 45^\circ$





From the diagram

$$\cos \delta = \frac{B_H}{B}$$

$$\begin{aligned} \Rightarrow B &= \frac{B_H}{\cos \delta} = \frac{3 \times 10^{-5}}{\cos 45^\circ} \\ &= 3\sqrt{2} \times 10^{-5} \text{ T} \end{aligned}$$

Question6

Earth's magnetic field always has a horizontal component except at

KCET 2021

Options:

- A. equator
- B. magnetic poles
- C. a latitude of 60°
- D. an altitude of 60°

Answer: B

Solution:



At poles magnetic dip, $\delta = 90^\circ$

As, horizontal component of Earth's magnetic field,

$$B_H = B \cos \delta$$

where, B is net earth's magnetic field.

$$\Rightarrow B_H = B \cos 90^\circ = 0$$

So, at poles, the horizontal component of earth's magnetic field is zero.

Question 7

A paramagnetic sample shows a net magnetisation of 8 Am^{-1} when placed in an external magnetic field of 0.6 T at a temperature of 4 K . When the same sample is placed in an external magnetic field of 0.2 T at a temperature of 16 K , the magnetisation will be

KCET 2020

Options:

A. $\frac{32}{3} \text{ Am}^{-1}$

B. $\frac{2}{3} \text{ Am}^{-1}$

C. 6 Am^{-1}

D. 2.4 Am^{-1}

Answer: B

Solution:

Given, $M_1 = 8 \text{ Am}^{-1}$, $B_1 = 0.6 \text{ T}$, $T_1 = 4 \text{ K}$, $B_2 = 0.2 \text{ T}$ and $T_2 = 16 \text{ K}$

According to Curie's law, for paramagnetic materials,



$$M = \frac{CB}{T}$$

$$\Rightarrow M_1 = \frac{CB_1}{T_1}$$

$$\text{and } M_2 = \frac{CB_2}{T_2}$$

$$\therefore \frac{M_2 \frac{CB_2}{T_2}}{M_1 \frac{CB_1}{T_1}} = \frac{B_2}{B_1} \times \frac{T_1}{T_2}$$

$$= \frac{0.2}{0.6} \times \frac{4 \text{ K}}{16 \text{ K}} = \frac{1}{3} \times \frac{1}{4}$$

$$\Rightarrow \frac{M_2}{M_1} = \frac{1}{12} \Rightarrow M_2 = \frac{M_1}{12} = \frac{8}{12}$$

$$\Rightarrow M_2 = \frac{2}{3} \text{ Am}^{-1}$$

Question8

In a permanent magnet at room temperature

KCET 2020

Options:

- A. magnetic moment of each molecule is zero
- B. the individual molecules have non-zero magnetic moment which are all perfectly aligned
- C. domains are partially aligned
- D. domains are all perfectly aligned

Answer: D

Solution:

At room temperature, all domains of permanent magnet are perfectly aligned like ferromagnetic material.



Question9

A magnetic needle has a magnetic moment of $5 \times 10^{-2} \text{ Am}^2$ and moment of inertia $8 \times 10^{-6} \text{ kgm}^2$. It has a period of oscillation of 2 s in a magnetic field B . The magnitude of magnetic field is approximately?

KCET 2019

Options:

- A. $1.6 \times 10^{-4} \text{ T}$
- B. $0.4 \times 10^{-4} \text{ T}$
- C. $3.2 \times 10^{-4} \text{ T}$
- D. $0.8 \times 10^{-4} \text{ T}$

Answer: A

Solution:

Given, Magnetic moment, $m = 5 \times 10^{-2} \text{ Am}^2$

Moment of inertia, $I = 8 \times 10^{-6} \text{ kgm}^2$

Period of oscillation, $T = 2 \text{ s}$

Since, $T = 2\pi\sqrt{\frac{I}{mB}}$, $T^2 = 4\pi^2 \frac{I}{mB}$

$$\Rightarrow B = \frac{4\pi^2 I}{T^2 m} = \frac{4 \times (3.14)^2 \times 8 \times 10^{-6}}{2 \times 2 \times 5 \times 10^{-2}} = 16 \times 10^{-4} \text{ T}$$

Hence, no option is correct.

Question10

A circular current loop of magnetic moment M is in a arbitrary orientation in an external uniform magnetic field B . The work done to rotate the loop by 30° about an axis perpendicular to its plane is



KCET 2019

Options:

A. MB

B. $\sqrt{3}\frac{MB}{2}$

C. $\frac{MB}{2}$

D. zero

Answer: D

Solution:

When the axis of rotation of loop is along the magnetic field, B by 30° about an axis perpendicular to its plane make no change in the angle made by axis of the loop with the direction of magnetic field.

As we know that,

$$W = MB \cos \theta$$

Here, $\theta = 90^\circ$

$$W = MB \cos 90^\circ = 0$$

Question11

In a permanent magnet at room temperature

KCET 2019

Options:

A. magnetic moment of each molecule is zero

B. the individual molecules have non zero magnetic moment which are all perfectly aligned.

C. domains are partially aligned

D. domains are all perfectly aligned

Answer: D



Solution:

At room temperature, the permanent magnet retains ferromagnetic property for a long period of time. Thus, domains are all perfectly aligned.

Question12

Needles N_1 , N_2 and N_3 are made of a ferromagnetic, a paramagnetic and adiamagnetic substance, respectively. A magnet when brought close to them will

KCET 2018

Options:

- A. attract all three of them
- B. attract N_1 strongly, N_2 weakly and repel N_3 weakly
- C. attract N_1 strongly but repel N_2 and N_3 weakly
- D. attract N_1 and N_2 strongly but repel N_3

Answer: B

Solution:

Let's analyze the properties of each substance:

Ferromagnetic materials (like iron) have strong magnetic domains and are very strongly attracted to magnets.

Paramagnetic materials have unpaired electrons that cause very weak attraction to magnetic fields.

Diamagnetic materials develop an induced magnetic moment that opposes the external magnetic field, leading to a weak repulsion.

Therefore, when a magnet is brought close:

It will attract the ferromagnetic needle (N_1) strongly.

It will attract the paramagnetic needle (N_2) weakly.

It will repel the diamagnetic needle (N_3) weakly.

Thus, the correct option is:

Option B: attract N_1 strongly, N_2 weakly and repel N_3 weakly.



Question13

The strength of the Earth's magnetic field is

KCET 2018

Options:

- A. constant everywhere
- B. zero everywhere
- C. having very high value
- D. varying from place to place on the Earth's surface

Answer: D

Solution:

To a first approximation, the Earth's magnetic field resembles a huge bar magnet. The field lines emerge from the southern half to northern half. The physical quantities, i.e. magnetic elements determine the strength of magnetic field. As magnetic declination, inclination or angle of dip and horizontal components of earth's magnetic field change from place to place hence strength of the earth's magnetic field varies from place to place. As angle of dip (δ) of a place changes its strength also changes.

Question14

A jet plane having a wing-span of 25 m is travelling horizontally towards East with a speed of 3600 km/hr. If the Earth's magnetic field at the location is 4×10^{-4} T and the angle of dip is 30° , then the



potential difference between the ends of the wing is

KCET 2018

Options:

A. 4 V

B. 5 V

C. 2 V

D. 2.5 V

Answer: B

Solution:

Let's work through the problem step-by-step:

The plane's speed is given as 3600 km/hr. First, convert this speed into meters per second:

$$v = 3600 \text{ km/hr} = \frac{3600 \times 1000 \text{ m}}{3600 \text{ s}} = 1000 \text{ m/s}$$

The Earth's magnetic field at the location is $B = 4 \times 10^{-4} \text{ T}$.

The dip angle is 30° , meaning the magnetic field makes an angle of 30° with the horizontal. Hence, the vertical (downward) component of the magnetic field is:

$$B_v = B \sin(30^\circ) = 4 \times 10^{-4} \times \frac{1}{2} = 2 \times 10^{-4} \text{ T}.$$

In such problems, the induced motional emf (electromotive force) for a conductor of length L moving through a magnetic field is given by:

$$\epsilon = B_{\perp} v L,$$

where B_{\perp} is the component of the magnetic field perpendicular to the conductor.

Here, the jet is traveling East, and it is typically assumed that the plane's wings are oriented North-South. Therefore, only the vertical component B_v contributes to the potential difference across the wings.

Using the values:

$$v = 1000 \text{ m/s}$$

$$L = 25 \text{ m}$$

$$B_v = 2 \times 10^{-4} \text{ T},$$

The induced emf is:

$$\epsilon = v L B_v = 1000 \times 25 \times 2 \times 10^{-4} \text{ V}.$$

Compute the value:

First, multiply $1000 \times 25 = 25000$.

Then, multiply $25000 \times 2 \times 10^{-4} = 25000 \times 0.0002 = 5 \text{ V}$.

Thus, the potential difference between the ends of the wing is 5 V, which corresponds to Option B.

Question15

The susceptibility of a ferromagnetic substance is

KCET 2017

Options:

A. Zero

B. > 1

C. < 1

D. $\gg 1$

Answer: D

Solution:

Ferromagnetic substances have a very strong response to an applied magnetic field. The magnetic susceptibility (χ) is defined by

$$\chi = \frac{M}{H},$$

where M is the magnetization and H is the applied magnetic field. In ferromagnets, even a small H can produce a very large M due to the alignment of magnetic domains. This is why the susceptibility is often much greater than 1.

To summarize the options:

Zero: Incorrect, because the material responds strongly.

> 1 : Although technically true, it doesn't emphasize how large the value can be.

< 1 : Incorrect, as this would be more typical for diamagnets.

$\gg 1$: Correct, because it indicates the susceptibility is many times greater than 1.

Thus, the correct answer is:

Option D: $\gg 1$.



Question16

Which of the following properties is 'False' for a bar magnet?

KCET 2017

Options:

- A. It doesn't produce magnetic field.
- B. Its like poles repel and unlike poles attract.
- C. Its poles cannot be separated.
- D. It points in North-South direction when suspended.

Answer: A

Solution:

The false property is Option A.

Here's why:

A bar magnet produces its own magnetic field. In fact, you can observe this magnetic field by the attraction and repulsion it exerts on other magnetic objects.

Option B is true since like poles repel and unlike poles attract.

Option C is true because if you break a bar magnet, each piece becomes a smaller magnet with its own north and south poles; you cannot isolate a single magnetic pole.

Option D is true since a freely suspended bar magnet will align itself along the North-South direction due to Earth's magnetic field.

Thus, the statement "It doesn't produce magnetic field" (Option A) is false.
